Waveline®

Encounter of the third kind

Innovative filtering media solutions for
the most demanding applications.

INDEX

CleanAir

DOMAIN

ⓘ USAGE

The Waveline is designed for use in dust collectors to **enhance the efficiency and performance of the filtration process** and the jet pulse cleaning operations.

⚙ WORKING PRINCIPLE

In jet pulse cleaning, compressed air is injected into the cages from a pipeline connected to a tank and operated by pulse valves. The scope of the shooting operation is to provoke the periodic fall of the dust cake into the hopper to renew the filter efficiency.

ADVANTAGES

UP TO:

+25% INCREASED AIR OUTPUT

or

+30% POWER REDUCTION

or

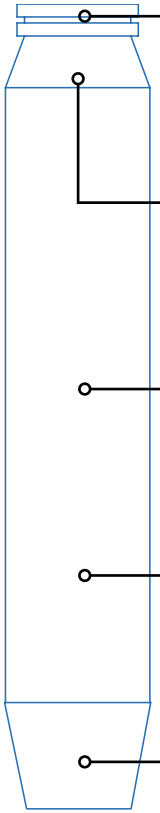
+50% COMPRESSED AIR REDUCTION

= LOWER ΔP
= LOWER ENERGY CONSUMPTION

Waveline is an innovative, patented filter bag able to **lower energy consumption** during its life cycle. It has purposefully been **designed to increase sustainability in dust collectors** using jet pulse technology.

CONSTRUCTION AND PARTS

↘ FILTER BAG



Double snap band

For universal and anti-leak superior filtering performances.

Conic collar fabric

Designed to increase the filtration area by up to 25%.

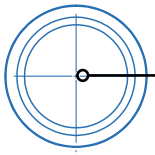
Identification label

With material and logo.

Cylindrical body

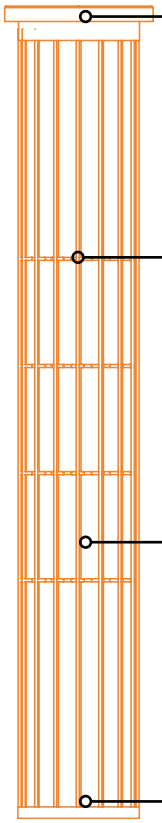
Reinforced bottom part

Engineered for extended durability in harsh environments.



The unique “milk bottle” shape maximizes the space between the cell plate holes, **increasing the filtration area** beyond the cell plate hole design’s geometric limitations.

↘ FILTER CAGE



Flat flange collar

It provides a stable configuration on the cell plate and a protected sleeve housing with a flat surface, making it ideal for connecting to venturis and digital beacons.

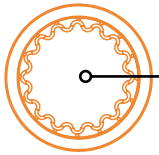
Star rings

One every 150 mm, they ensure optimal support for the filter media and maintain its integrity under varying conditions.

Double ring junction

The ideal solution for applications requiring a multi-part cage.

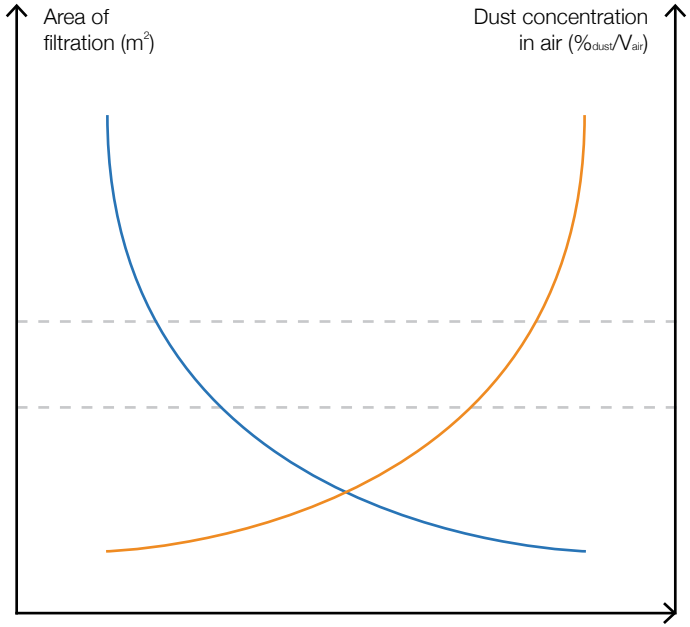
Bottom steel plate



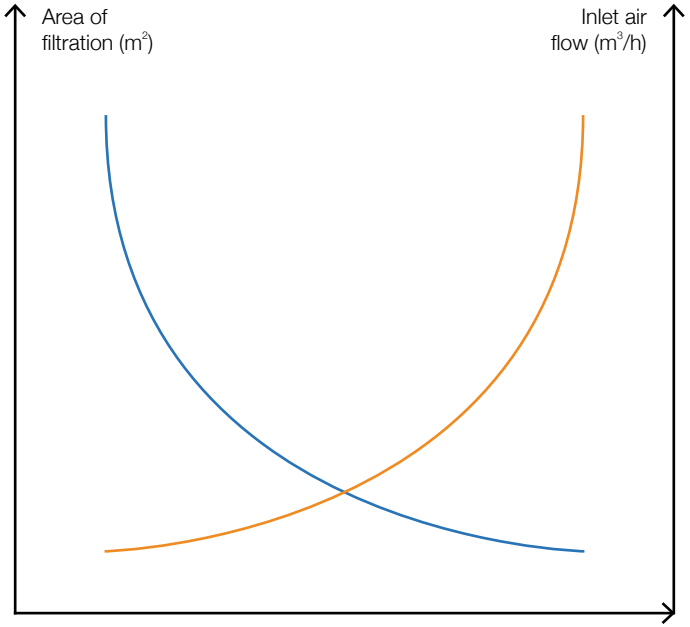
The 16 longitudinal wires provide **optimal support for the filter bag**. Their profile is specifically designed to match the broader fabric area of Waveline.

CONCEPT AND PATENTS

Dust cake formation is a function of filtration area and dust concentration.



Dust cake forming (Kg/t) over time



Material permeability ($10^{-12}m^2$)

01. (left graph)

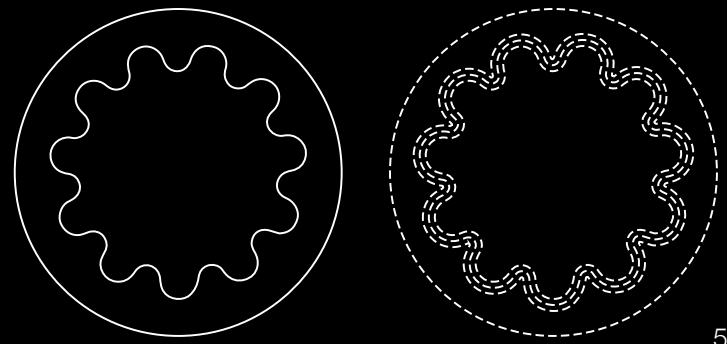
By maintaining a consistent dust air concentration, **a wider filtration area**, like that in Waveline, **reduces the increase of differential pressure.** The increased filtration area of Waveline prolongs the time needed for dust cake buildup, providing clear advantages for cleaning operations.

02. (right graph)

Depending on its permeability, **a larger filtration surface allows for the treatment of a higher volume of incoming air**, thereby significantly enabling enhancement of the upstream processes.

® GLOBAL PATENT PROTECTION

Maximizing the filter chamber area to increase the total filtration area is a patented concept owned by Kappa Filter Systems. This innovation promises significant advancements in filtering operations, particularly beneficial for large-scale filter applications.



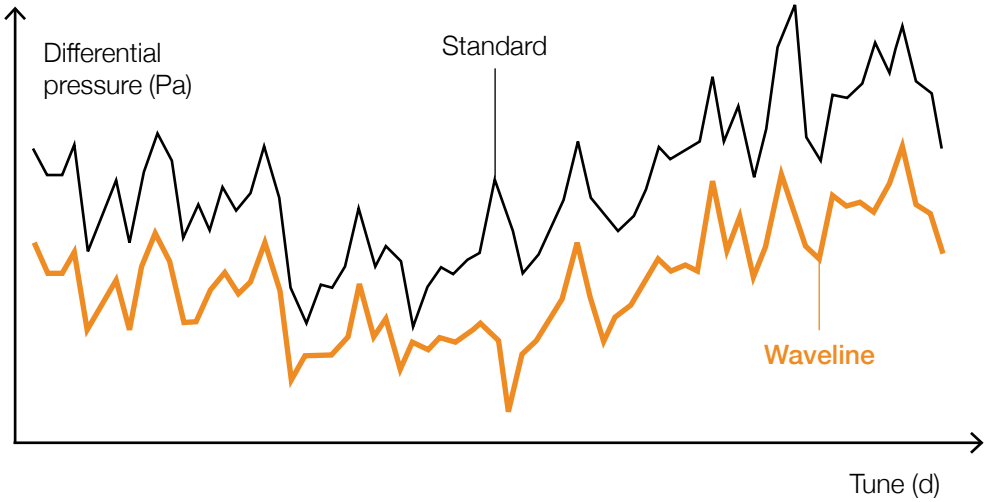
PATENT WO/2010/040158

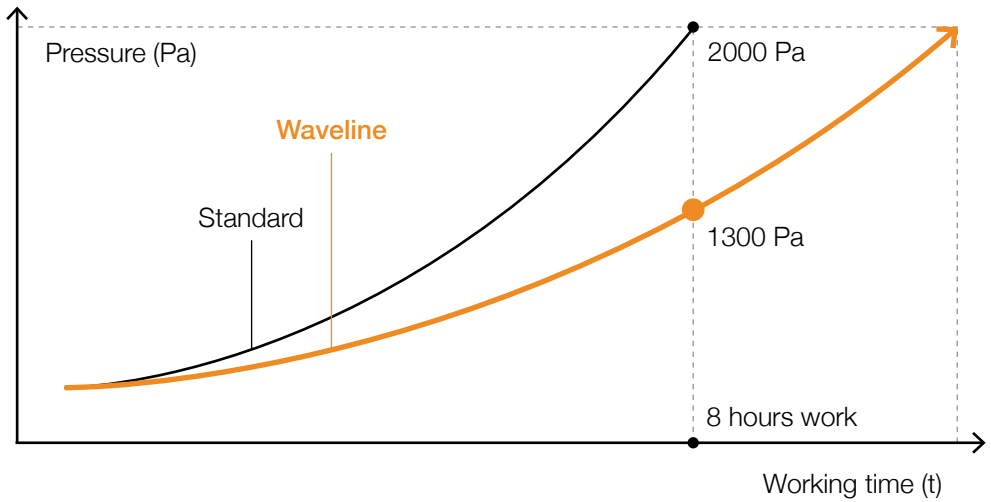
PROCESS AND TECHNOLOGY

The increased filtration area offers several benefits, including either **higher air output** or **reduced power consumption** and **consumption of compressed air**. With a larger filter area, you can choose to increase air output by maintaining the same filter area load. Reducing the filter area load lowers the average differential pressure, which in turn decreases energy consumption (if a frequency converter is installed). The lower initial differential pressure allows for longer cleaning cycles if the cleaning threshold remains unchanged after converting to the Kappa Waveline filter element.

WORKING

CLEANING





DURATION OF WAVELINE FILTERS (until cleaning threshold)*

The independent and renowned research institution of ILK Dresden conducted comparative performance tests against traditional round section filter bags. Specimens were loaded up to 2000 Pa differential pressure between the raw and clean gas chambers. **Waveline filters demonstrated a significantly lower increase in differential pressure**: after 8 hours of operation, Kappa Waveline showed 700 Pa less differential pressure.

↖ Dust concentration: 5 g/m^3; Filter bag length: 6 meters

CASE HISTORY: WAVELINE ACHIEVEMENTS

CASE STUDY #1

In the case of this customer, the standard filter bags were replaced with Waveline filter bags. This **saved energy and therefore also reduced CO2 consumption** in Scope 2. As the same material can be used for the Waveline filter bag as previously used by the customer, the lifetime of the filter elements can be expected to remain the same. **The improved cleaning settings also save a lot of compressed air.**

- 930 Kappa Waveline filter bags and support baskets exchanged
- Due to the decrease in differential pressure made possible by the Waveline, ~57% of energy in comparison to the previous filter elements is saved.
- Difference in energy costs: ~ 60,000 € -70,000 € in the first year (depending on the operating hours estimation of around 6,500h)
- **Estimated energy cost savings after 10 years: > €500,000** (assuming energy costs remain the same)
- Air performance / volume flow: 300,000 Bm³/h
- Annual volume flow: 1,650,000,000 Bm³/h
- Switching to Waveline bag filters reduced energy requirements of the filter bags by over 50% in the initial phase. Given the current situation on the energy market and the general rise in costs, the Waveline system offers extraordinarily strong potential for optimization in order to master the current economic challenges.

CASE STUDY #2

The goal was to **minimize emissions** while benefiting from the Waveline® filter bag, to which the dedusting system was upgraded. This was achieved through an enlarged filter surface, leading to **significant energy savings**. This innovation optimized the company's circular economy and reduced pollutant emissions to a comparative minimum.

- The filter is equipped with Kappa Waveline® filter bags
- 452 Waveline® filter bags
- Significant savings in terms of energy costs and CO2 emissions
- Difference in energy costs: around 45,700 €
- Amortization period: 25 months
- Bag filter change: every 8 years
- **Expected savings after 15 years: ~ 557.400 €**
- CO2 savings: 47 tons
- Air output/volume flow: 105 304 Nm3/h
- Annual volume flow: 1,008,000,000 Bm3/year

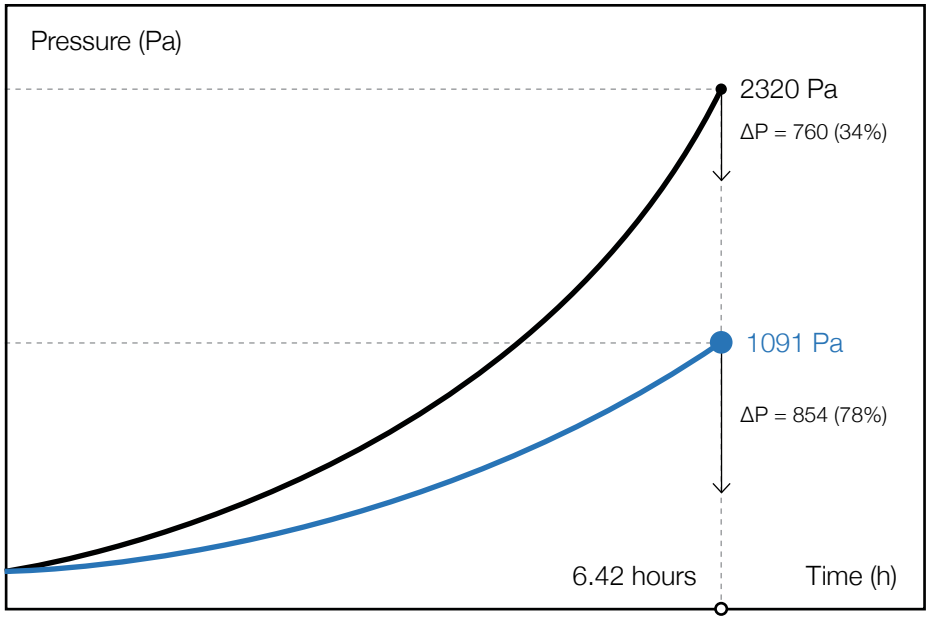
CASE STUDY #3

A renowned filter bag manufacturer tested Waveline filter bags to compare their **estimated lifespan** to standard filter bags.

The interim results showed that the Waveline filter elements remained in very good condition after 150,000 pulses, leveraging from the additional filtration surface. Standard filter bags deteriorated substantially after around 100,000 pulses. The post analysis concluded that there was no significant difference in remaining material strength between the two, indicating that **Kappa Waveline filter elements have at least the same lifespan as standard filter bags**.

ENERGY SAVINGS

INCREASED DUST RELEASE

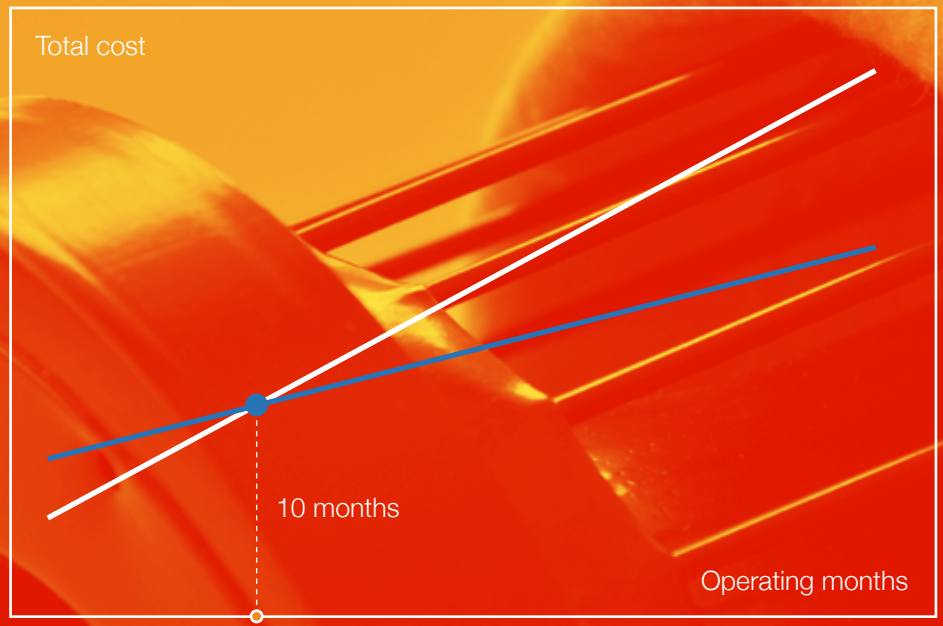


After a 6.2-hour test conducted by ILK Dresden, the **Waveline filter achieved a lower differential pressure** (1091 Pa) compared to a traditional filter. **The Waveline's design significantly enhances cleaning efficiency**, achieving a notable 78% improvement.

In the specific study conducted, the Waveline filter bag required only 34% of the energy needed for the same filtration task compared to the standard filter bag.

STANDARD FILTER BAG
WAVELINE FILTER BAG

HIGHER ENERGY SAVINGS



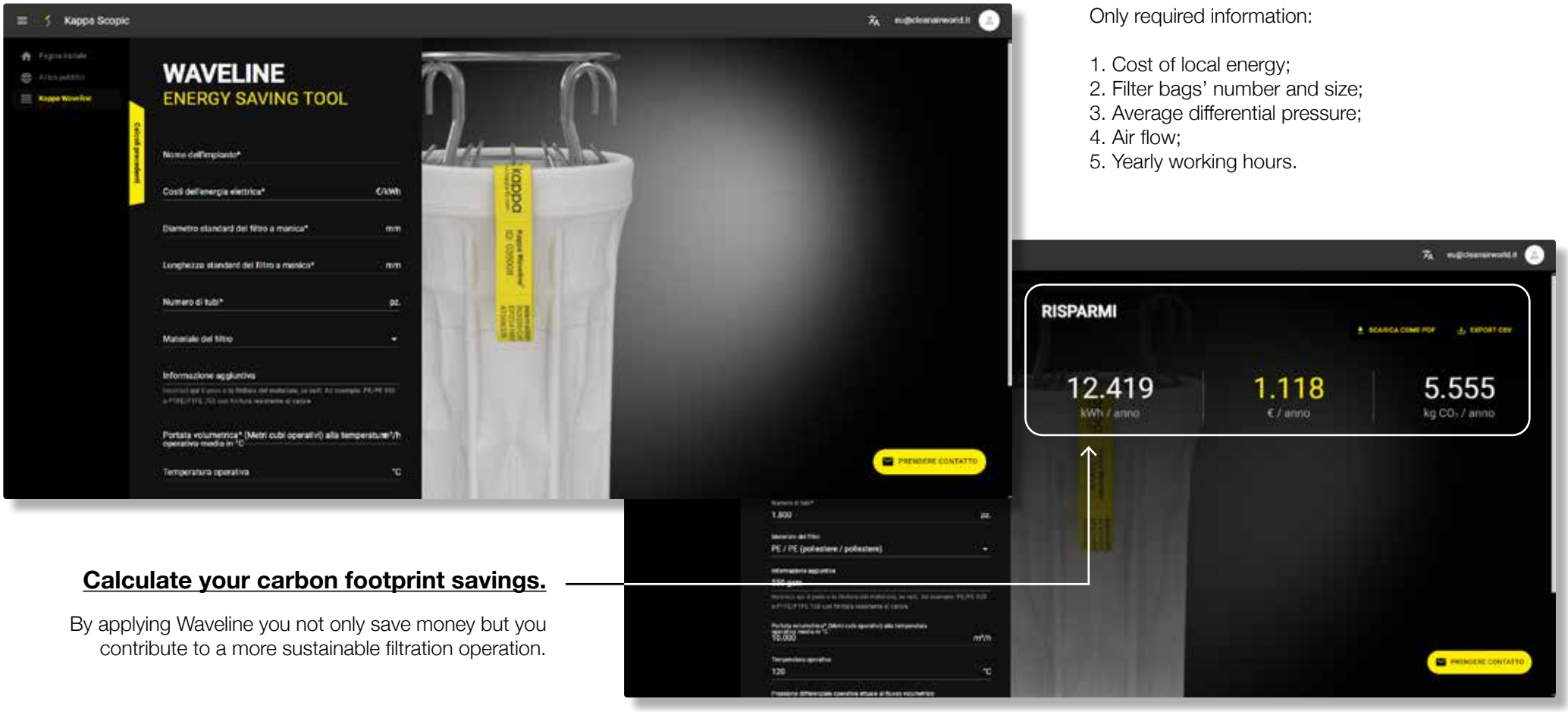
The main benefit of the Waveline's increased filtration area is **energy savings** in both working (fan) and cleaning (compressor and valves) processes. Using the patented Waveline filter bag and filter cage, compared to a standard filter bag with a standard support cage, typically results in a **return on investment within 12 to 24 months**, depending on conditions. Moreover, the energy savings continue well beyond this period. The significantly lower energy consumption originates from:

1. Slower increase in differential pressure
2. Improved cleaning operations (online and offline)
3. Lower compressed air consumption

SOFTWARE

HOW MUCH DOES THE FILTERS DESIGN AFFECT PERFORMANCE? HOW MUCH ENERGY CAN IT SAVE?

The Waveline filter significantly advances decarbonization in dust collectors. With a few simple steps on the Kappa Scopic software, **you can easily access energy savings, financial benefits, and a reduced carbon footprint.**



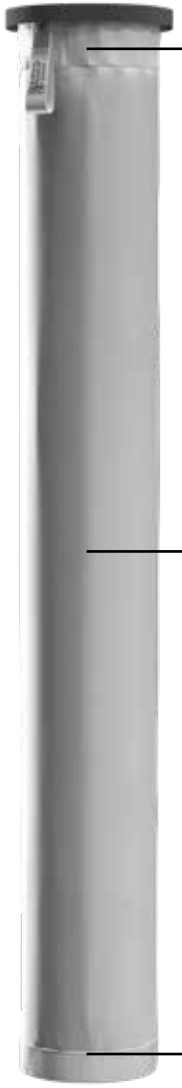
Only required information:

1. Cost of local energy;
2. Filter bags' number and size;
3. Average differential pressure;
4. Air flow;
5. Yearly working hours.

Calculate your carbon footprint savings.

By applying Waveline you not only save money but you contribute to a more sustainable filtration operation.

FILTER BAG CONSTRUCTION



Top construction

Many variations, customizable

Main body

Thermo sealed or sewed

Bottom construction

Many variations, customizable

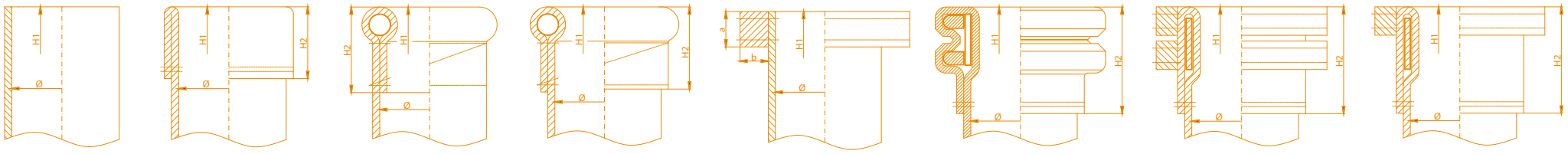
At CleanAir, we aim to provide efficient dedusting solutions by **lowering emissions, saving energy, and contributing to decarbonization**. Each sleeve is carefully manufactured and adapted to the customer's needs.

Particle size	Applications	Dust cake layer (g/m^2)	Pulse jet air cloth (m/min)	Felt weight (g/m^3)
Course (10-200 micron)	Grain, paper, flour, fertilizer, plastic	250	2.5 - 3-5	400
Medium (5-100 micron)	Tobacco, sugar, leather	300	2.0 - 3.0	500
Fine (3-20 micron)	Cement, asphalt, limestone, foundry	400	1.5 - 2.0	500 - 550
Very fine (0.5-20 micron)	Steel furnace, metal oxides, carbon	500	1.0 - 1.5	500 - 650 + membrane
Smoke & fume (<0.2-10 micron)	Smelting fune, alu oxides	> 600	0.75 - 1.2	> 540 + membrane

BOTTOM AND TOP DESIGN

The top and bottom parts of the filter bag often need to be customized based on the plant's construction features. Depending on the attachment method, a split ring or a rubber washer may be required.

TOP FILTER BAG CONSTRUCTION ↘



Raw edge | Hem | Inner hem | Outer hem | Snapring single felt | Snapring double felt | Cut edge | Snapring

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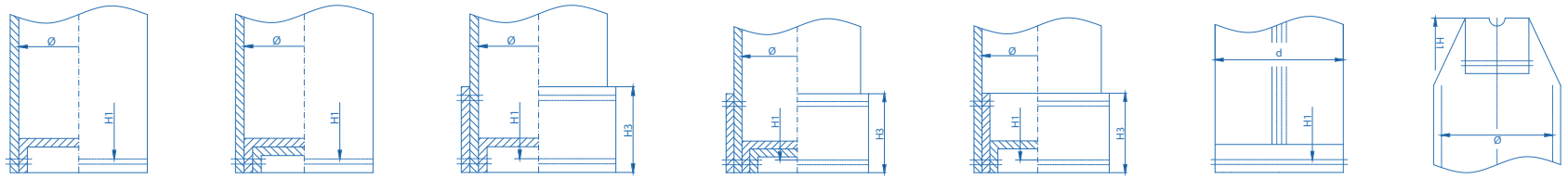
The bottom construction of the bag is often reinforced, as this area is typically exposed to harsher conditions.

BOTTOM FILTER BAG CONSTRUCTION ↘



Standard | Double | Reinforced | Reinforced double | Inner reinforce | Hooked loop | Flat

FILTER BAG MATERIAL

Scrim and type fibers	Continuous temperature (Peak temperature)	Designation	Hydrolysis Resistance	Acid Resistance	Alkali Resistance	Oxidation Resistance
Polypropylene	95 °C/(95 °C)	PP	excellent	excellent	excellent	limited
Polyamide	110 °C/(115 °C)	PA	limited	limited	good	limited
Polyacrylnitrile copolymer	115 °C/(120 °C)	AC	limited	limited	good	good
Temperature-resistant olefin	125 °C/(135 °C)	RO	excellent	excellent	excellent	limited
Polyacrylonitrile homopolymer	125 °C/(140 °C)	DT	good	good	good	good
Polyester	150 °C/(150 °C)	PE	limited	good	limited	good
Polyphenylene sulphide	190 °C/(200 °C)	PPS	excellent	excellent	excellent	limited
m-Aramide	200 °C/(220 °C)	NO, NX	limited	limited	limited	good
Polyimide	240 °C/(260 °C)	PI	good	limited	limited	good
Polytetrafluorethylene	250 °C/(280 °C)	PTFE, TFL	excellent	excellent	excellent	excellent
Fibreglass fabric	260 °C/(288 °C)	GL, WG	good	limited	limited	excellent

PRICE (€) PP PE ACRYLIC Fiberglass PPS FMS ARAMID PTFE P84 →

TEMP. (C°) PP PE ACRYLIC (130 - 150) PPS (160 - 190) ARAMID (204 - 240) P84 and FMS (240 - 260) PTFE/Fiberglass (260 - 280) →

MOISTURE PE ARAMID PP P84 PPS FMS Fiberglass ACRYLIC PTFE →

FILTER SYSTEMS USAGE:

- Dedusting
- Process filter
- Product filter
- Combustion filter
- Silo top filter
- Jet pulse filter
- Reverse filter

FINISHINGS

CALENDERING

The calendering operation consists in squeezing the needle felt fabric into two hot rollers. Its purpose is to modify the textile surface features to adapt to the desired permeability level.

MEMBRANE LAMINATION

In a special laminating machine, a PTFE membrane is bonded to the material's outer fabric layers to reduce emissions and improve dust cake release.

COATINGS AND IMPREGNATION

PTFE: a double coating on the fibers increases chemical resistance.
WOP: a special water and oil repellent is used as a protective fabric treatment, covering the fibers with a chemical shield.

FIRE PROTECTION

In case of customer demand, we offer a specialized fire retardant treatment rated "Class B1," along with a premium fireproof felt option rated "Class A" for enhanced safety and protection.

HEAT SETTING

It's a special operation performed to heat stabilize filter felts and minimize residual shrinking. This process typically involves heating the fabric to a specific temperature and maintaining it for an extended period.

ANTI STATIC PROTECTION

A stainless steel wire mesh inserted inside the core of the filter decreases the overall surface resistivity of the woven felt, reducing the risk of electrostatic sparks.

SINGEING

The singeing operation uses a controlled gas flame to burn off all residual tissue hairs. This process eliminates protruding fibers, giving the fabric a smoother appearance.

ACID PROTECTION

A special coating can be applied whenever high resistance to acidic environments is needed.

APPLICATION FIELDS

MINERALS AND AGGREGATES

Customized applications depend on the diverse treatments of various minerals in aggregate form. From asphalt to fertilizers, and lime to coal, filtration tasks often occur in atmospheres with corrosive gas conditions and harsh environments.

IRON AND STEEL

A large quantity of pollutants is typical in steel applications. The high temperatures of applications such as furnaces and casting operations require the best materials for fine dust emission control and long-term resistance.

ALUMINIUM

Although part of the metal casting filter bag family, Aluminum deserves special attention. Handling, drying, calcining, electrolytic reducing, and casting can all generate significant pollutants which need to be controlled and taken care of.

CEMENT

Cement plants typically have a high need for ventilation and filtration. From milling coals and meals to transportation, ovens, and coolers, high-temperature filters are often required to control powder emissions in aggressive gas environments.

PLASTIC

The polymer industry requires filter bags that ensure safe conditions against fire and explosions, featuring controlled surface resistivity and antistatic properties.

POWER GENERATION

Even though new fuel materials are emerging, coal remains the primary fuel used in power generation. The high temperatures involved often require very high-quality filter fabrics to meet strict emission limits.

WASTE INCINERATOR

PTFE is the ultimate fiber used in these plants, which often burn various types of waste at very high temperatures. Extremely acidic or basic gases require resistant fabric media with PTFE membranes to reduce particulate emissions.

FOOD AND DIARY

Food and dairy filtering applications face the challenge of treating powder in a clean environment with potential moisture and combustible dust. Processes such as blending, drying, milling, and roasting may all require a baghouse.

WOOD AND BIOMASSES

Wood paste, wood dust and pellets are usually filtered in potentially dangerous and highly flammable environments. For this reason, anti static polyester filter bags are usually used for such applications.

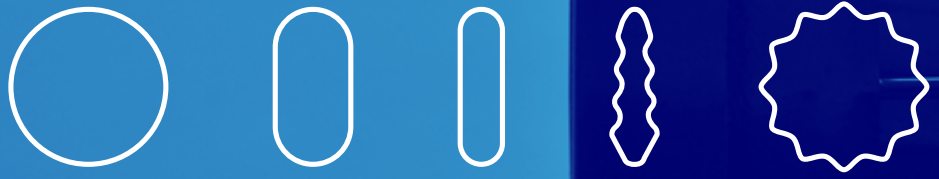
PHARMA AND CHEMICALS

Expensive dust in the pharmaceutical field, for example, may necessitate sterile Teflon filter bags. Other materials and applications can also be employed based on the specific chemicals that are being processed.

ACCESSORIES

RANGE

Filter bag shapes in CleanAir can vary from round to oval, luehr, or flat. Additionally, we offer the production of customized filter bags on demand. Before placing the order in production, we provide detailed drawings and samples for confirmation. We typically request the dimensions and thickness of the cell plate hole.



COUPLING CAGE AND BAGS

As a cage manufacturer, CleanAir Europe manages to ensure the perfect coupling of the filter's cage with the outer bag. Accurate and precise play between these elements is indeed crucial, as it impacts dust cake release and filtration efficiency. Relying on us means getting a state-of-the-art filter cage, coupling filter bags with their supports and achieving extremely high efficiency levels.

ACCESSORIES

ECO SMART TAG AND LABEL:

CleanAir Europe's special digital beacon helps trace cage and bag information, offering comprehensive support and details for both product and installation.

ECOTURBO:

The EcoTurbo Venturi can be chosen to enhance dust cake release performance by increasing the peak pressure wave of the injected compressed air.

CAGES:

We offer a wide range of cages in various formats, including oval, round, starred, luehr, and flat sections. Custom formats are also available upon request.

LEAKAGE POWDER:

We provide fluorescent leakage powder to detect filter bag leaks in dust collectors, ensuring proper fitting and maintenance.

Clean Air

Your filtration's support

JULY 24TH - REV. 1

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